

# Experience with Consultation



- ◆ Formosat-2 is an EESS satellite operating in the 8275-8395 MHz close to the deep space band 8400 – 8450 MHz
- ◆ It is operated by Taiwan which is not a member of the ITU
- ◆ It was Launched on 20 May 2004 by a Taurus XL vehicle
- ◆ Distribution of images is made by SpotImage

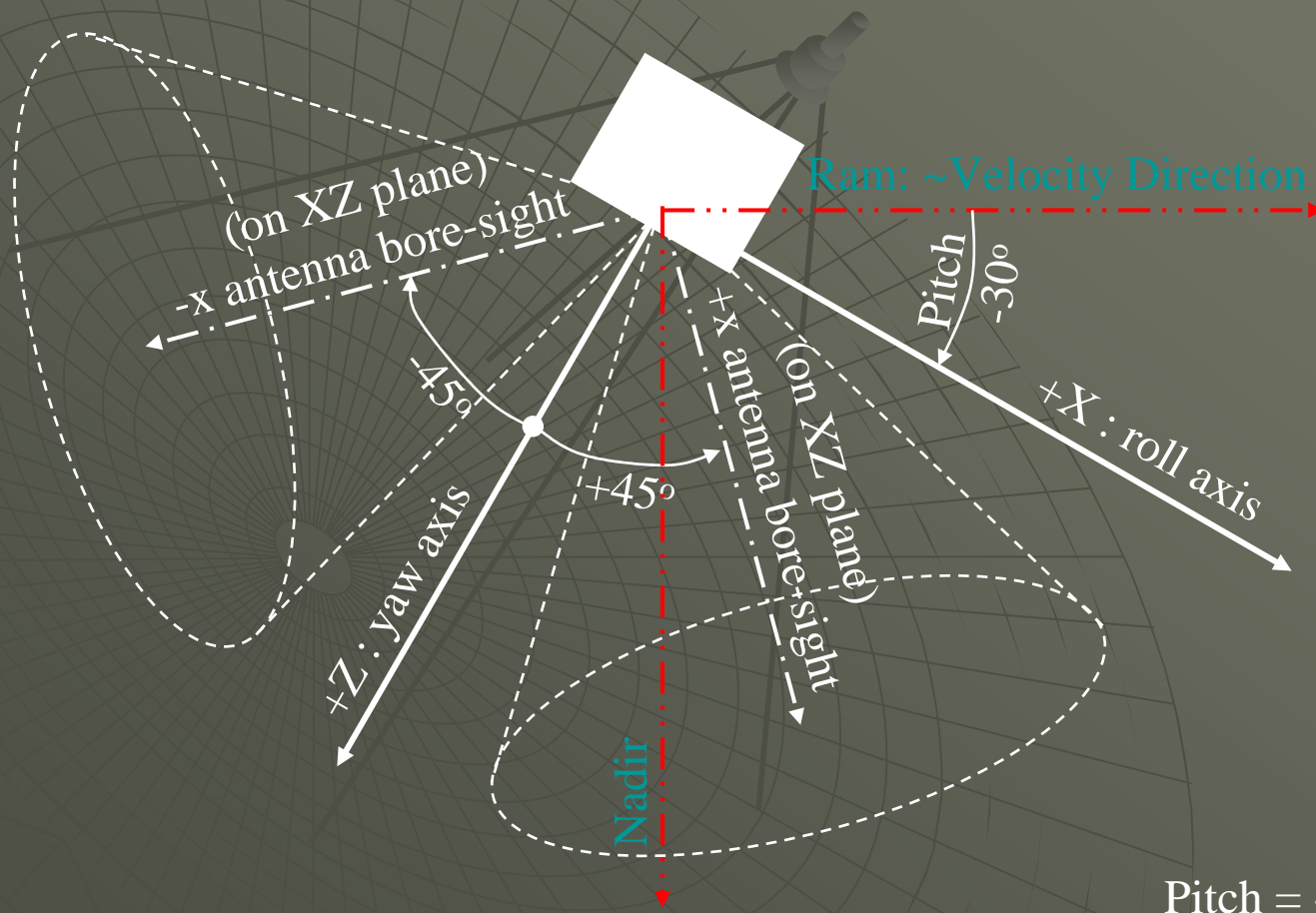
- ◆ Appendix 4 information were presented at SFCG for consideration by other space agencies and sent directly to administrations
- ◆ Coordination was completed with all administrations prior to launch for the X-band station in Taiwan.
- ◆ Further information were presented at SFCG-24 and sent to space agencies and administrations when receiving earth stations were added to the program

## ***FORMOSAT-2 Orbit Parameters***

- ECF State Vector
  - UTC Time: 2004/11/22 00:00:00
  - Position: (-5369.8622, 3269.4754, 3642.7923) km
  - Velocity: (-2.1815213, 3.5439304, -6.2977139) km/sec
- Mean Semi-major Axis: 7266.60 km
- Mean Inclination: 99.129°
- Mean Eccentricity: 0.0002

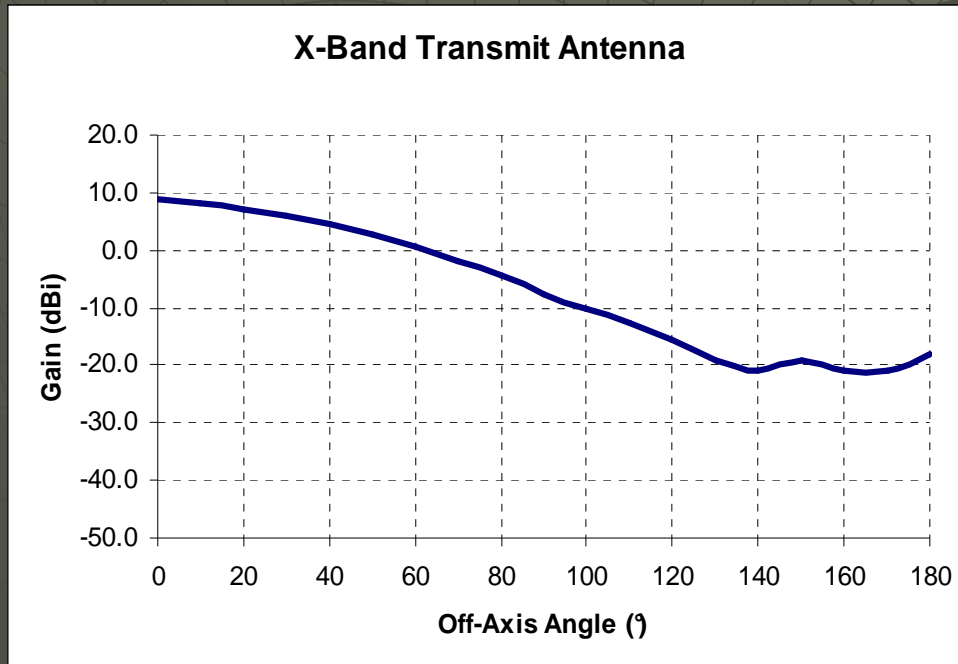
## FORMOSAT-2 Attitude at Downlink

- ◆ Satellite attitude could be off from nadir pointing by
  - -  $45^\circ \leq \text{Roll} \leq 45^\circ$
  - -  $45^\circ \leq \text{Pitch} \leq 45^\circ$





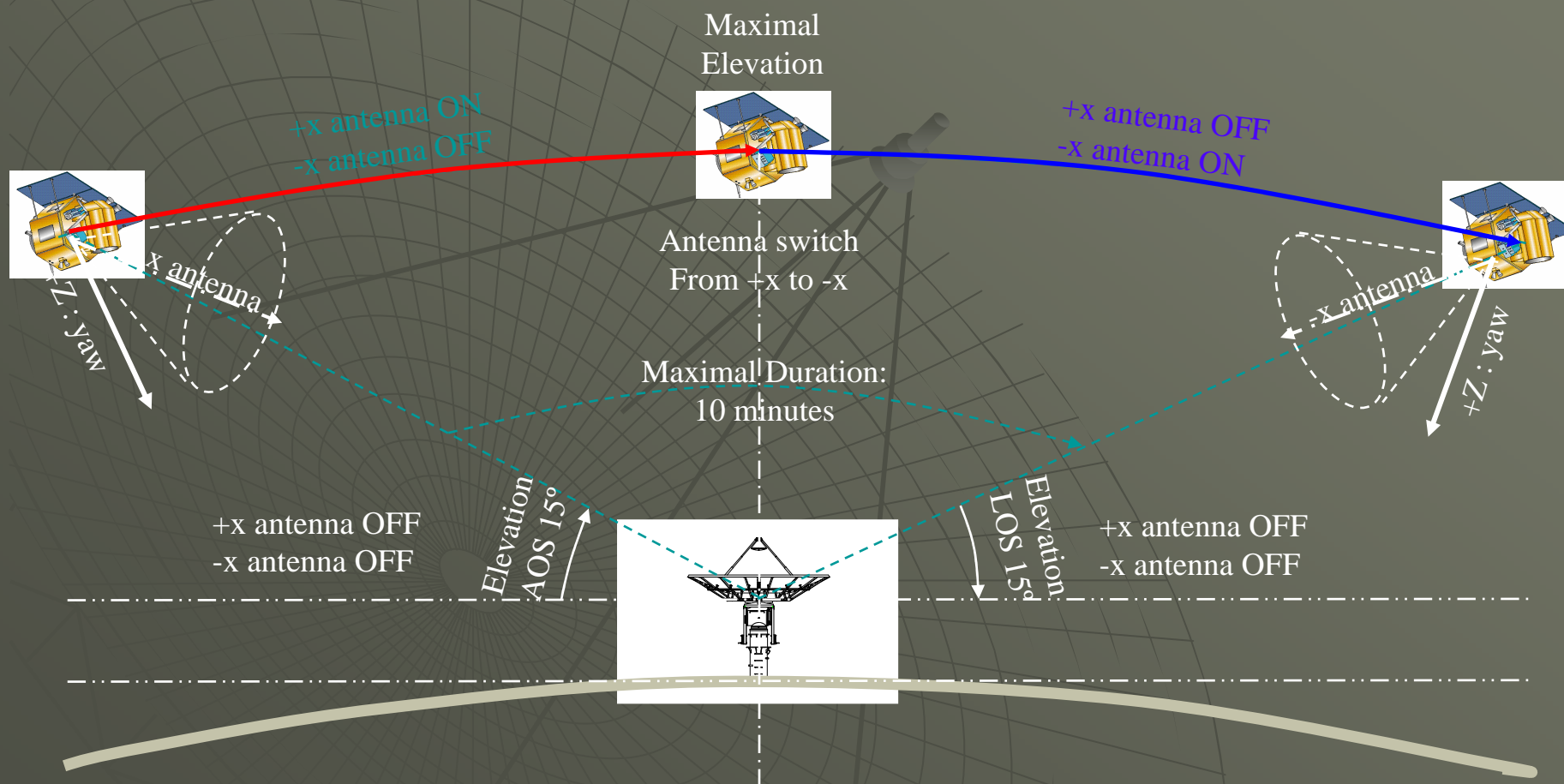
## FORMOSAT-2 +x, -x Antenna Pattern



Deg	dB
0	8.8 ,
5	8.7 ,
10	8.6 ,
15	8.1 ,
20	7.6 ,
25	7.0 ,
30	6.1 ,
35	5.5 ,
40	4.8 ,
45	3.5 ,
50	2.5 ,
55	1.4 ,
60	0.0 ,

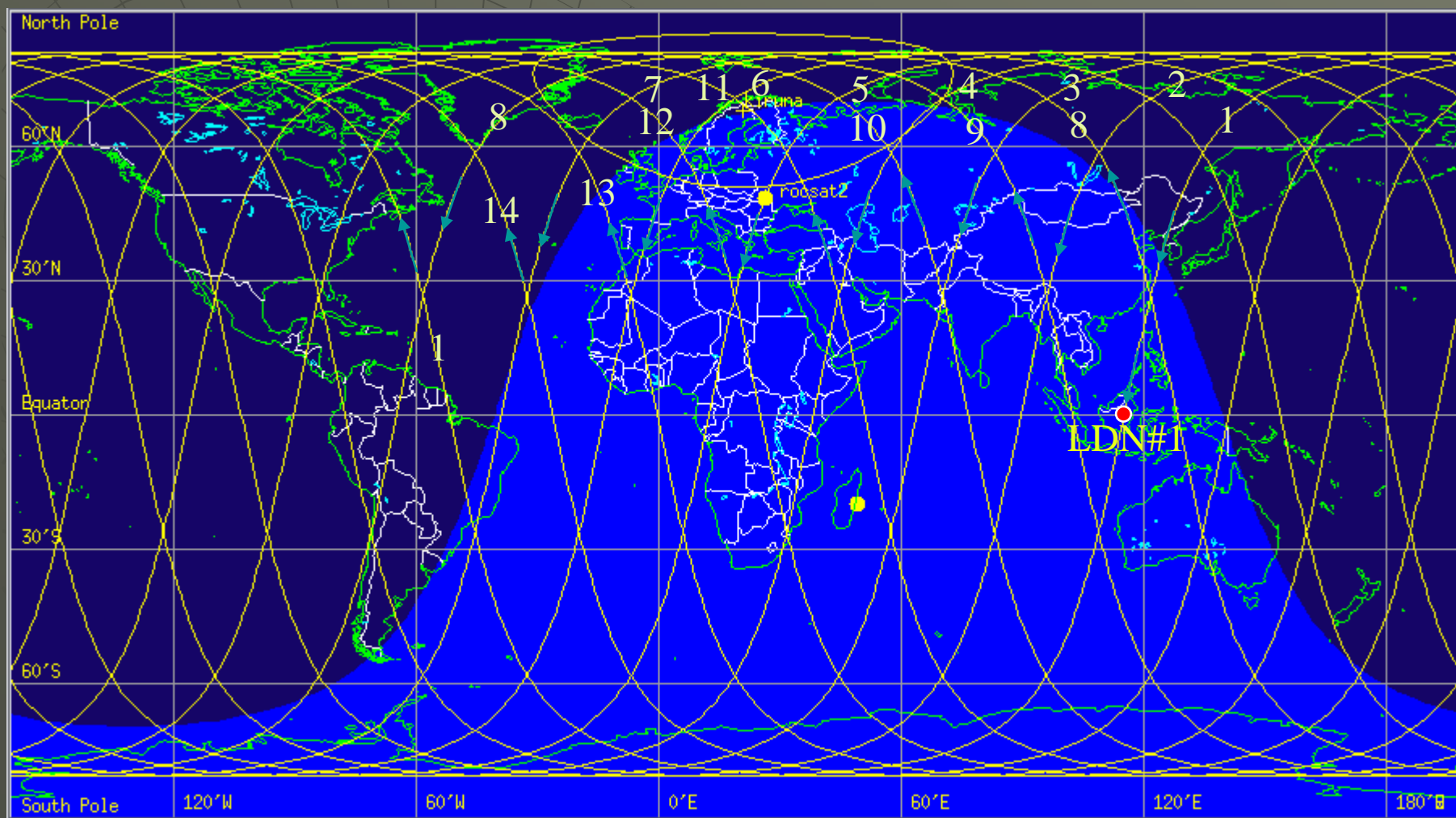
Deg	dB
65	-1.0 ,
70	-2.2 ,
75	-3.8 ,
80	-4.8 ,
85	-6.1 ,
90	-7.0

## FORMOSAT-2 +x, -x Antenna Operation



## FORMOSAT-2 Ground Track

- ROCSAT-2 ground track repeats everyday (14 revolutions/day)
- Longitude of descending node of orbit #1:  $114.2^{\circ}\text{E} \sim 116.2^{\circ}\text{E}$  (LDN#1)





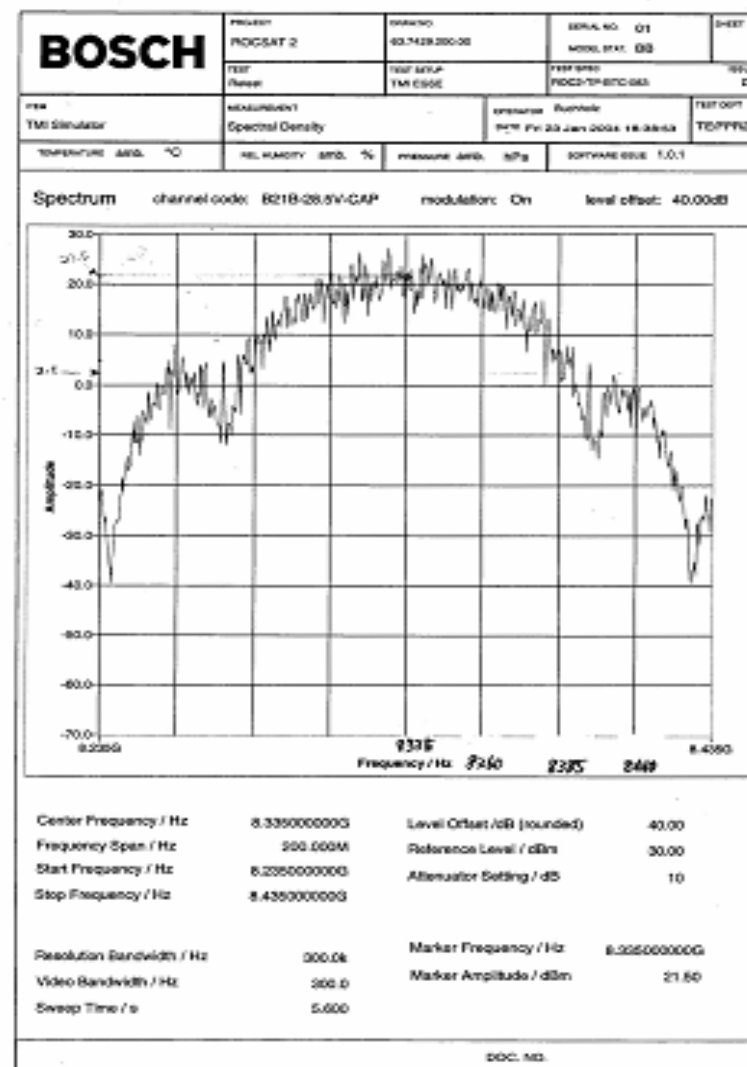
## Kiruna Downlink Candidates AOS/LOS Times

- Drift of AOS/LOS times could be  $\pm 15$  minutes.

Orbit Number	15°AOS Time (UTC)	15°LOS Time (UTC)	Maximal Elevation	Contact Duration (min.)
4	06:51:26	06:53:55	15.9°	2.48
5	08:31:15	08:40:12	43.5°	8.95
6	10:12:50	10:22:27	74.1°	9.62
7	11:54:32	12:02:46	35.5°	8.23
8	13:35:45	13:42:16	24.4°	6.52
9	15:15:49	15:22:32	25.2°	6.72
10	16:55:21	17:03:53	39.1°	8.54
11	18:35:54	18:45:37	84.7°	9.71
12	20:18:35	20:27:07	37.0°	8.53

# FORMOSAT-2 Spectral Density Attenuation at 8400~8450 MHz

- ◆ Attenuation
  - Required: 57 dB
  - Actual: 20 dB



## RFI from FormoSat-2 Downlink at Kiruna into NASA DSN at Madrid

- ◆ FS2 PFD(min) at DSN Elevation 0° at 8400~8450 MHz
  - -224 (dBW/m<sup>2</sup>/Hz) + S/C antenna gain (attitude related)
  - S/C antenna gain = [9, -21] dB (with respect to [0°, 180°] off-axis angle)
  - [-215, -245] dBW/m<sup>2</sup>/Hz
- ◆ DSN required PFD
  - < -255 dBW/m<sup>2</sup>/Hz
  - ITU-R SA1157
- ◆ Mitigation Options from NASA
  - FormoSAT-2 turns off transmitter whenever the DSN-to-FormoSat elevation angle is above 4.7 degree
  - FormoSat-2 maneuvers attitude to reduce the PFD level into the DSN Madrid DSN Complex below ITU protection level. (can't meet ITU level)

## Impacts : Turnoff at Madrid EI > 4.7°

Orbit No.	15°AOS Time (UTC)	15°LOS Time (UTC)	Maximal Elevation	Contact Duration (min.)
4	06:41:11	06:43:32	15.8°	2.35
5	08:20:57	08:29:52	43.2°	8.93
6	10:02:32	10:12:09 10:09:07 (EI=46°)	74.4°	9.62 6.58 (-3.04)
7	11:44:14	11:52:28 11:51:46 (EI=19°)	35.6°	8.23 7.53 (-0.7)
8	13:25:28	13:31:58	24.3°	6.51
9	15:05:32	15:12:13	25.1°	6.69
10	16:45:04	16:53:35	38.8°	8.51
11	18:25:36	18:35:18	84.2°	9.69
12	20:08:16 20:12:09 (EI=37°)	20:16:49	37.2°	8.54 4.67 (-3.87)

Same consultation process is going on for the Fairbanks earth station

